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Combined Effects of Aging and a Pro-Diabetic Diet on Retinal Function in a Murine Model of Aging of the Human Eye

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Abstract

Purpose: Improvement of life expectancy and changes in the dietary behaviour of developed populations are accompanied with the prevalence of diabetes and age-related ocular pathologies. Aging of the retina is characterized by accumulation of lipids at the basement of the retinal pigment epithelium - Bruch's membrane complex. Meanwhile increased oxidative stress is one of the features of aging and diabetes. A fructose-rich diet induces insulin resistance and hypertriglyceridemia, mimicking diabetes. The goal of our study was to evaluate the effects of a pro-diabetic fructose-enriched diet on the retinal function of the $ApoB_{100}$,$LDLR^{-/-}$ mice, a murine model of aging of the human eye.

Methods: Four month-old $ApoB_{100}$,$LDLR^{-/-}$ and SF2J control mice were bred under either a standard chow or a fructose-enriched diet (60%) during 6 months (n=6 in each group). The functionality of the retina was evaluated by single flash electroretinography (ERG) under scotopic conditions to assess the global response of the retina. The a-wave was used to reflect the response of photoreceptors, and the b-wave the response of the inner layers of the retina. Flicker ERG was monitored by increasing flash intensity at a 10Hz-fixed frequency of the stimulus to specifically assess the sensitivity of rods and cones.

Results: The fructose-enriched diet significantly decreased a- and b-wave amplitudes of the retina to single flash ERG in both strains of animals. This fructose-induced diminution was intensified in $ApoB_{100}$,$LDLR^{-/-}$ mice compared to controls at a flash intensity of 2500mcds/m²: -55.5% versus -33.4% for the a-wave ($p<0.01$), -41% versus -38% for b-wave ($p<0.05$), respectively. The fructose-enriched diet impaired the sensitivity of rods by 0.3 log unit (44 versus 20mcds/m², respectively) in both strains of mice without affecting that of cones.

Conclusions:A pro-diabetic diet enhanced the effects of aging on the retina by reducing its functionality and impairing its sensitivity to light stimulus. Oxidative stress may be one of the mechanisms involved in these effects.

Keywords: aging • electroretinography: non-clinical • nutritional factors